19 FRENCH REPUBLIC

NATIONAL INSTITUTE OF INDUSTRIAL PROPERTY

PARIS
---

11 Publication no.: (to be used only for ordering copies) 2 355 197

A1 **PATENT APPLICATION**

21 **No. 76 18280**

54 **Device for transmission of forces for steering, in particular for steering the automotive vehicle.**

51 International classification (Int. Cl.[2]) ..... F 16 C 7/00; B 62 D 7/20.

22 Application date ..... June 16, 1976, 3:58 p.m.
33 32 31 Priority claimed:

41 Date application was disclosed to the public ..... B.O.P.I. – "Lists" no. 2 dated 01/13/78.

71 Applicant: Company called: SOCIETE ANONYME AUTOMOBILES CITROEN, residing in France.

72 Invented by:

73 Holder: *Idem* 71

74 Attorney: Offices of Plasseraud.

Forms sold by IMPRIMERIE NATIONALE, 27, rue de la Convention – 75732 PARIS CEDEX 15

The invention relates to a device for transmission of forces for steering, of a type that comprises a first element formed by an articulating element, in particular a pivot pin, that is able to be displaced along a first trajectory and a pushing and pulling rod between this first element and a second element that can be displaced according to a second trajectory that is slightly inclined with respect to the first one and such that the center axle of the rod will have an inclination with respect to the two trajectories that is relatively slight and that is variable.

The invention more specifically concerns, since it is in this case that its application seems to be of the most interest, but not exclusively, a device for transmission of force for steering an automotive vehicle and more specifically, for steering control that is assisted and has a slight reduction ratio, as well as for a vehicle in which the assembly of the steering axle and the parts making up the steering gear is very rigid.

Above all, the object of the invention is to produce the device for transmission of force such that it responds better than to date to various requirements in practice so that it makes it possible to ensure a progression of the forces transmitted and an increase in the reduction ratio in the area of each "neutral" position, i.e. corresponding to a force transmitted by the device that is practically zero; the device must also have secure function, in particular in the case of steering the vehicle.

According to the invention, a device for transmission of force for steering, of the type defined above is characterized in that it comprises on one hand, a sleeve of elastomer or similar material, with its axis essentially parallel to that of the rod, the said sleeve is located between the two elements and comprises an external part connected in translation to one of the elements and an internal part connected in translation to the other element in such a way that this sleeve operates with shear depending on the average direction of its axis for transmission of forces and, on the other, rigid stop means that are able to limit, in the two possible relative movement directions between the two elements, the relative displacement of these two elements, allowed by deformations of the elastic sleeve,

these stop means being able to ensure a positive transmission of the movement when they go into action.

Preferably, the external part of the sleeve of elastic or similar material is attached to an essentially cylindrical housing that surrounds this sleeve, a housing in which the seat of a pivot pin making up the articulation element is provided, this seat being adjacent to the elastic sleeve.

The internal part of the elastic sleeve is advantageously attached to an inserted bushing, which is screwed in an adjustable manner on one threaded end of the rod.

The rigid stop means, for each of the relative directions of movement possible between the two elements, are formed, on one hand, by the transverse surfaces extending radially toward the interior of the housing and connected in translation to this housing and, on the other, by the stop surfaces provided on the bushing and able to cooperate with the abovementioned transverse surfaces in the direction of the deformation of the sleeve.

Preferably, the inserted bushing comprises, on the side opposite the pivot pin, a shoulder that projects radially toward the outside, making up one of the surfaces of the stop and able to cooperate with a transverse shoulder projecting radially toward the inside provided at one end of the housing, the other end of the bushing being able to come to a stop against the base of the pivot pin seat.

The external part of the sleeve of elastomer or similar material is attached with a rigid cylindrical casing, especially metallic, blocked in the housing, in particular between an internal shoulder of this housing and the base of the seat of the pivot pin. The sleeve of elastomer or similar material may comprise, on the side of the pivot pin seat, a part that projects axially that is able to come to a stop against the base of the seat before the internal metallic bushing of the sleeve comes in contact with the said seat after deformation of the sleeve.

The rigid stop means, according to one embodiment variation, can comprise one or several rings pressed around either the bushing attached to the internal part of the sleeve or in the housing and blocked in translation with respect to the bushing and/or the sleeve with the use of means such as an elastic ring anchored in a throat in the bushing or the housing.

The invention also concerns the industrial product consisting of the assembly of the pivot pin, of the housing comprising the pivot pin seat, the sleeve of elastomer material housed in the housing and the bushing attached to the internal part of the sleeve of elastomer material.
The invention also concerns steering of a vehicle, in particular steering with assisted control equipped with the transmission device provided for above.
Apart from the provisions explained above, the invention consists of certain other provisions which will be involved more specifically below with regard to specific embodiments that are not limiting and are described with reference to the attached drawings.
Figure 1 of this drawing shows a diagram, partially in cross section, of a device for transmission of force according to the invention. Finally, Figures 2 and 3 show embodiment variations of the device for transmission of force shown partially.
With reference to Figure 1, it is possible to see a device 1 for transmission of force for steering of an automotive vehicle. This device comprises a first element e formed by a spherical pivot pin 2 that makes up the articulating element. This pivot pin can be displaced according to a first trajectory (rectilinear direction) indicated by the double arrow D. The pivot pin comprises a threaded handle 3 that is able to be screwed into the end of a sliding rod, in particular a rack.
Device 1 also comprises a connecting rod 4 between the first element e and a second element f that is able to be displaced according to a second curvilinear trajectory c that is slightly inclined with respect to D. The acute angle between the trajectory c and D remains, in the majority of cases, less than 30°. This trajectory c is such that the center axle of the rod 4 has an inclination, with respect to the two trajectories, that is relatively slight (less than 30° in the majority of cases) and that is variable.
This second element f is made up of an axle around which an eye 4b provided at the end of the rod 4 is mounted, with the possibility of rotation, the axle f is connected at the center of the wheel that can be steered of the vehicle and turned with this center around the axis of the pivots of the wheel that can be steered. The geometric axis of the element f

moves according to the trajectory c represented in the diagram.
The angular position of the rod 4 is thus variable with respect to the direction D, since the trajectory of element f is not parallel to D.
A sleeve 5 of an elastomer material, or of a similar material or equivalent, is located between elements e and f, the axis of this sleeve being essentially parallel to that of the rod 4; more specifically, the axis of sleeve 5 is parallel to the axis of the part 4a of the rod adjacent to this sleeve.
The external cylindrical part 5a of the sleeve is connected in translation to element c. This part 5a is attached, in particular by adhesion, to a cylindrical metallic casing 6.
This casing 6 is blocked in housing 7, which is essentially cylindrical; the seat 8 of the pivot pin 2 is provided in this housing and is adjacent to the elastic sleeve 5.
The end 7a of the housing surrounding the pivot pin 2 is pushed back toward the axis of this housing in such a way as to ensure a blocking of the seat and of the pivot pin in the housing.
The seat 8 is made in two parts 8a, 8b. The part 8a that directly surrounds the pivot pin 2 is arranged in such a way as to allow it to deform when part 7a is driven in, in order to mold to the shape of the pivot pin 2. The part 8b makes up a bowl located on the inside of housing 7 behind part 8a.
The tubular casing 6 is blocked axially between the rear flat face of the bowl 8b and an internal shoulder 7b of housing 7.
The internal part 5b of the sleeve is attached, in particular by adhesion, with a rigid inserted bushing 9, screwed in a way that can be adjusted on the threaded end 4a of the rod 4. A lock nut 10 ensures blocking of the bushing 9 on the end 4a.
Rigid stopping means B are provided to limit the amplitude of relative displacement possible between elements e and f, a displacement that is produced by deformations in shear, parallel to its axis, of sleeve 5.
These means B, for each of the directions of movement, are formed on one hand by transverse surfaces 11, 12 extending radially toward the inside of housing 7 and connected in translation

to this housing and on the other, by stop surfaces 13, 14 provided on the bushing 9 and able to cooperate, respectively, with the surfaces 11, 12 mentioned above.
In Figure 1, the transmission device is shown in a neutral position in which no force is being transferred. The axial distance h between surfaces 11 and 13 determines the maximum displacement from the neutral position between the housing 7 and the bushing 9 when the latter moves toward the left with respect to the housing 7.
The distance j between surfaces 12 and 14 determines the maximum amplitude of the possible displacement in the other direction between the bushing 9 and the housing 7.
In the embodiment of Figure 1, the surface 11 is made up of the internal surface of a collar 15 located at the end of the housing 7 at a distance from the pivot pin 2.
The surface 12 is made up by the rear face of the bowl 8b.
The stop surface 13 is formed by the transverse face of an external radial shoulder 16 of the bushing 9. The stop surface 14 is formed by the end of the bushing 9 adjacent to the bowl 8b.
A radial play r is provided between the opening limited by the collar 15 and the external surface of the bushing 9.
Figures 2 and 3 show embodiment variations.
In Figure 2, it can be seen that the external metal tubular casing 6a attached to the external part of the elastic sleeve 5 is extended axially beyond the sleeve on the side opposite the pivot pin in such a way as to come to a stop axially against a ring 17, which itself is in contact with the collar 15 of the end of the housing 7. This ring, independent of housing 7, replaces the shoulder 7b provided in Figure 1 and is no longer necessary in the embodiment in Figure 2.
Still in the variation in Figure 2, another ring 18 is mounted around the bushing 9 in such a way as to be located between the ring 17 and the sleeve 5 in the axial direction. An elastic snap ring 19 anchored in the throat provided on the external surface of bushing 9 makes up a unilateral stop for the ring 18 in such a way as to keep the sleeve 5 at a distance axially. This ring 18 replaces the shoulder 16 in the embodiment in Figure 1. The faces across from each other of rings 17 and 18

make up rigid stop means that are able to positively transmit the forces between the housing 7 and the rod 4 at the time of a displacement of the housing 7 from the left toward the right in Figure 2.
The housing 7, in the embodiment in Figure 2, comprises an internal annular shoulder 20 having a tapered surface 21 turned toward the pivot pin. This shoulder makes it possible to produce a bowl similar to that formed by part 8b in Figure 1. A central opening 22, provided in the center of this shoulder, is closed by a rigid plate 23 against which the deformable part 8a of the seat of pivot pin 2 comes to rest.
The sleeve 5, in the case of Figure 2, comprises an axial extension 5c in the form of a crown at its end adjacent to pivot pin 2. This extension comes in contact with the rear flat face 12a of shoulder 20.
The other elements of the device in Figure 2 that are identical to the elements in Figure 1 are indicated with the same reference numbers.
In the embodiment in Figure 3, the external tubular casing 6b attached to the external part of the sleeve 5 extends, from the side opposite the pivot pin 2 to the collar 15 of housing 7. This casing 6b itself comprises a collar 24 that projects radially toward the interior. This collar 24 is able to cooperate with the shoulder 16 of the bushing 9 when the axial play between this collar 24 and the shoulder 16 has disappeared as a result of the deformation of sleeve 5.

In the embodiment in Figure 3, the sleeve 5 comprises an axial extension 5d on the side of the pivot pin 2, formed of a piping making contact on the rear face 12 of the bowl 8b.
The other elements of the device in Figure 3 similar to the elements in Figure 1 are indicated with the same reference numbers.
It should be noted that in the case of Figures 1 and 3, the installation of the assembly of the device is carried out through the right end of housing 7 while the part 7a has not been deformed radially toward the interior.

When all the elements have been put in place on the inside of this housing 7, the part 7a is driven back radially toward the inside in such a way as to capture the pivot pin 2.
In the case of Figure 2, the pivot pin 2 is always mounted through the right of housing 7 and the deformation of the end 7a takes place after installation of this pivot pin 2. In contrast, the sleeve 5 is mounted through the left end of housing 7 before that collar 15 has been formed. This collar 15 is produced by deformation of the left end of the housing 7 after the sleeve 5 has been put in place.
This being the case, no matter which embodiment, the device functions in the following manner.
When the device is in neutral position, i.e. when the force transmitted by the device is practically zero, the sleeve 5 is not deformed and the axial plays h and j have their normal values.
If, starting from this neutral position, the pivot pin 2 is displaced by a control element, such as a steering wheel, in the case of steering a vehicle, the sleeve 5 deforms to transmit the force of the control. This deformation will be proportional to the force transmitted. Thus, it appears that a given displacement of pivot pin 2, in the vicinity of the neutral position, following a direction D will correspond to a lower-amplitude displacement of the rod 4 as a result of the deformation of sleeve 5.
This sleeve 5 thus introduces an end play, proportional to the force transmitted, and thus produces an excess of reduction on either side of the neutral position, between the displacements of the control element such as the steering wheel of a vehicle and the element controlled, for example element f.
When the force transmitted becomes greater than a given value corresponding to the deformation of sleeve 5 that cancels one of the axial plays h or j, the excess of reduction is suppressed since the force is transmitted directly and positively by rigid stop means, either 11, 13 or 12, 14. Thus, it appears that the sleeve 5 will not be subject to excessively elevated stresses that will have a negative effect on its service life.
The device of the invention is especially interesting in the case of steering a vehicle, for control

that is assisted and has a slight reduction ratio. The changes, the turns (above all those corresponding to low forces at the steering wheel), and holding in a straight line are easier due to the relative flexibility created between the rack and the wheels, especially if the steering gear itself has high stiffness. Due to the sleeve 5 that introduces an excess of reduction in the vicinity of any neutral position of the steering wheel, driving the vehicle is clearly improved.

The device of the invention can function with great angular clearances between the rod 4 and the displacement direction D of the pivot pin 2, due to the spherical articulation of this pivot pin in housing 7.

The device requires little construction space and has a low cost, due to the reduced number of parts and to the combination of several elements: pivot pin, elastic sleeve, inserted bushing 9 that the end of the rod 4 is screwed into to allow adjustment, in particular adjustment of the toe-in or the toe-out of the wheels of a vehicle.

Because of its diameter and its relatively small thickness, the sleeve 5 has a slight radial flexibility in compression; this sleeve 5 is able to filter vibrations. The axial length of the sleeve 5 can be chosen freely in such a way that it is possible to ensure great axial flexibility in shear, in the direction of the forces transmitted, which makes it possible to best select the reduction ratio for the low forces transmitted.

The elastic sleeve makes possible slight axial plays due to the action of forces created at the level of the wheels and due to rolling, which translate into a reduction of the vibrations and shocks transmitted to the steering wheel when the vehicle is moving over a road that is not completely flat.

It should be noted that the combination of the sleeve 5 and the pivot pin 2 in the same housing makes it possible to transmit forces with a relatively large angular play between the rod 4 and the direction D, not only due to the presence of the pivot pin 2, but also due to the proximity of the pivot pin and the sleeve 5, of which the radial deformations would have an effect essentially on the buckling of the rod 4/housing 7 assembly, than if this sleeve were located at a distance from the ends of this assembly, and in particular at a distance from the pivot pin 2.

Thus, the device of the invention makes it possible to ensure a transmission of force with great play and with a predominant elasticity in the direction of the forces transmitted.

CLAIMS

1. Force transmission device for steering, in particular for steering a vehicle, comprising a first element made up of a pivot pin that is able to be displaced along a first trajectory and a pushing and pulling rod between this first element and a second element that is able to be displaced along a second trajectory slightly inclined with respect to the first and such that the center axle of the rod has an angle with respect to the two trajectories that is relatively slight and variable and comprising on one hand, a sleeve of elastomer or similar material, with an axis essentially parallel to that of the rod, the said sleeve is located between the two elements and comprises an external part connected in translation to one of the elements and an internal part connected in translation to the other element in such a way that this sleeve works in shear according to the average direction of its axis for transmission of forces and on the other, rigid stop means that are able to limit, in the two possible relative directions of movement between the two elements, the displacement of these two elements made possible by the deformations of the elastic sleeves, these stop means being able to ensure positive transmission of the movement when they go into action, the external part of the sleeve or elastomer or similar material being connected to a housing that is essentially cylindrical surrounding this sleeve, characterized in that a seat is provided in the housing for the pivot pin, this seat being adjacent to the elastic sleeve and that the end of the housing surrounding the pivot pin is driven back toward the axis of the housing in such a way as to capture the pivot pin on the inside of this housing.

2. Device according to Claim 1, characterized in that the internal part of the elastic sleeve is connected to an inserted bushing screwed in an adjustable manner on the threaded end of the rod.

3. Device according to Claim 2, characterized in that the rigid stop means are formed, on one hand, by transverse surfaces extending radially toward the inside of the housing and connected in translation to this housing and on the other, by stop surfaces provided on the bushing and able to cooperate with the said transverse surfaces

BM/CP 14.77 Z.
5/2/77 -

depending on the direction of deformation of the sleeve.

4. Device according to Claim 2, or according to the combination of Claims 2 and 3, characterized in that the inserted bushing comprises, on the side opposite the pivot pin, a shoulder that projects radially toward the outside that is able to cooperate with a transverse shoulder projecting radially toward the inside provided at one end of the housing, the other end of the bushing being able to come to a stop against the base of the pivot pin seat.

5. Device according to any one of the preceding claims, characterized in that the external part of the sleeve of elastomer or similar material is attached to a rigid cylindrical casing, especially metallic, blocked in the housing, especially between an internal shoulder of this housing and the base of the pivot pin seat.

6. Device according to Claim 2, or according to the combination of Claims 2 and one of Claims 3 to 5, characterized in that the sleeve of elastomer material comprises, on the side of the pivot pin seat, a part projecting axially that is able to come to a stop against the base of the seat before the internal metallic bushing of the sleeve can come into contact with the seat after deformation of the sleeve.

7. Device according to Claim 2, characterized in that the stop means comprise one or several rings connected either around the bushing or in the housing and blocked in translation with respect to the bushing and/or the housing.

8. Assembly for a device for transmission of forces for steering, in particular for steering a vehicle, characterized in that it comprises a housing on the inside of which a pivot pin is enclosed and the pivot pin seat and a sleeve of elastomer material housed between the pivot pin seat and the other end of the housing, an inserted bushing that is attached to the internal part of the sleeve of elastomer material, while the external part of this sleeve is attached to a rigid cylindrical casing blocked in the housing.

9. Vehicle steering system, in particular with assisted control, characterized in that it is equipped with a device for transmission of force according to any one of Claims 1 to 7.